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(Reaffirmed 2003)

Indian Standard

METHOD FOR WEATHERING TEST ON IRON ORE SINTER

Ores and Raw Materials Sectional Committee, SMDC 16 [Ref : Doc : SMDC 16 (3105)]

1. Scope — This standard prescribes the method for weathering test on iron ore sinter.

2. Test Sample — A batch of 500 kg of finished sinter either from the sintering plant or produced in the laboratory by pot/pan sintering should be taken for this purpose. The properties of sinter, both physical and chemical, along with the chemical and screen analysis as listed in Appendix A should be determined prior to weathering test.

3. Test Procedure — The entire quantity of the material should be left to weather under any one of the following conditions:

a) Under a shed,
b) In the open without any shed in dry season, or
c) In the open without any shed in the rainy season.

Which of the three conditions is used, should be specified. Alternatively, four batches each of 100 kg of sinter may be kept separately on the ground in the same manner. Each batch could be drawn on the stipulated period for various tests. This is to be done preferably under a shed so as to protect it from direct sun/heavy rain. Samples of at least 100 kg should be drawn at a time to determine its properties at a regular interval. The sample should be drawn after a period of 15 and 30 days. On each sample, at least two tests should be conducted to check on the reproducibility of the results.

3.1.1 The test may also be carried out beyond 30 days, if mutually agreed upon.

4. Presentation of Results — All the sinter properties determined by the above method during the various time intervals shall be tabulated as shown in Appendix B.

APPENDIX A

(*Caluse* 2)

TEST FOR SINTER QUALITY DATA

Sl No.	*Item*	*Test No. 1*	*Test No. 2*
1.	Tubular strength (*see* IS : 6495-1984 'Method of tumbler test for iron oxides: lump ores, sinter and pellets (*first revision*)'		
2.	Shatter strength (*see* IS : 9963-1981 'Determination of shatter index of iron ore lumps, sinter and pellets')		
3.	Reduction degradation (*see* IS : 10823-1984 'Methods for determination of thermal degradation index (TDI) and reduction degradation index (RDI) of iron oxides: lump ore, sinter and pellets, Section 1 Static degradation test, Section 2 Dynamic degradation test')		
4.	a) Reducibility, (dR/dt) at 40% reduction (*see* IS : 8167-1976 'Method for determination of reducibility of iron ore sinter')		

(*Continued*)

Adopted 25 April 1988

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Sl No.	*Item*	*Test No. 1*	*Test No. 2*
	b) Relative reducibility, total mass loss at the end of 3 h (*see* IS : 11292-1985 'Determination of relative reducibility of iron oxides: lump ore, sinter and pellets')		
5.	Softening characteristics (*see* IS : 9660-1980 'Guidelines for determination of softening characteristics of iron core pellets')		
	a) Softening start temperature,		
	b) Softening end temperature, and		
	c) Softening range temperature.		
6.	Chemical analysis of sinter, percent (*see* IS : 1493-1959 'Methods of chemical analysis of iron ores')		
	Fe (Total)		
	FeO		
	SiO_2		
	Al_2O_3		
	CaO		
	MgO		
	MnO		
	S		
	P		
	$Na_2O + K_2O$		
	Free lime (*see* Appendices C and D)		
7.	Basicity		
	CaO/SiO_2 or		
	$\frac{CaO + MgO}{SiO_2}$ or		
	$\frac{CaO + MgO}{SiO_2 + Al_2O_3}$		
8.	Sieve analysis, percent		
	+ 40 mm		
	+ 25 mm		
	+ 10 mm		
	+ 5 mm		
	– 5 mm		

APPENDIX B

(*Clause* 4)

SINTER QUALITY UPON WEATHERING (WEATHERING CONDITION SHOULD BE MENTIONED)

Sl No.	*Item*	*Period of Test*	
		15 days	30 days
1.	Tubular strength (*see* IS : 6495-1984)		
2.	Shatter strength (*see* IS : 9963-1981)		
3.	Reduction degradation (*see* IS : 10823-1984)		
4.	a) Reducibility, (dR/dt) at 40 % reduction (*see* IS : 8167-1976)		
	b) Relative reducibility, total mass loss at the end of 3 h (*see* IS : 11292-1985)		
5.	Softening characteristics (*see* IS : 9660-1980)		
	a) Softening start temperature,		
	b) Softening end temperature, and		
	c) Softening range temperature.		
6.	Chemical analysis of sinter, percent (*see* IS : 1493-1959)		
	Fe (Total)		
	FeO		
	SiO_2		
	Al_2O_3		
	CaO		
	MgO		
	MnO		
	S		
	P		
	$Na_2O + K_2O$		
	Free lime (*see* Appendices C and D)		
7.	Basicity		
	CaO/SiO_2 or $\frac{CaO + MgO}{SiO_2}$ or $\frac{CaO + MgO}{SiO_2 + Al_2O_3}$		
8.	Sieve analysis, percent		
	+ 40 mm		
	+ 25 mm		
	+ 10 mm		
	+ 5 mm		
	− 5 mm		

APPENDIX C

(*Appendices* A *and* B)

DETERMINATION OF FREE LIME IN IRON ORE SINTER BY VOLUMETRIC METHOD
(Referee Method)

C-1. Outline of the Method — A suitable aliquot of the solution is titrated against the standard oxalic acid solution. The free lime is estimated directly as CaO.

C-2. Reagents

C-2.1 *Sugar*

C-2.2 *Phenolphthalein Indicator* — 0·1 percent in ethanol.

C-2.3 *Standard 0·1 N Oxalic Acid Solution* — Dissolve 6·303 g $H_2C_2O_4.2H_2O$ in distilled water and dilute to 1 000 ml. The solution ordinarily need not be standardized as the weight of the oxalic acid is constant (standardize against standard $\frac{N}{10}$ $KMnO_4$).

C-3. Procedure — 1 g of finely ground sample is placed in a 500 ml glass-stoppered bottle. 30 g of sugar and about 300 ml of water are added and the bottle shaken vigorously. The solution is diluted to 500 ml and shaken at ten minute intervals for 1½ to 2 hours. Then the insoluble material is allowed to settle, part of the solution filtered through a coarse filter paper, 50 ml of the filtrate drawn out with a pipette into an Erlenmeyer flask, two drops of phenolphthalein indicator added, and the solution titrated with 0·1 N oxalic acid solution till the pink colour disappears. The lime is reported as percent available CaO.

1 ml 0·1 N oxalic acid = 0·002 8 g CaO.

APPENDIX D

(*Appendices* A *and* B)

DETERMINATION OF FREE LIME IN IRON ORE SINTER BY ATOMIC ABSORPTION SPECTROPHOTOMETRIC (AAS) METHOD

D-1. Outline of the Method — A suitable aliquot of sugar solution of iron ore sinter is aspirated in AAS and measured at 422·7 nm.

D-2. Reagents

D-2.1 *Sugar*

D-2.2 *Calcium Standard Solution* — Dissolve 1·248 7 g of anhydrous calcium carbonate in 100 ml of dilute hydrochloric acid (1 : 3). Transfer to one litre volumetric flask. Transfer 10 ml of the solution to 200 ml volumetric flask. Dilute and mix (1 ml = 25 μg Ca).

D-2.3 *Iron Background Solution* — Dissolve 10 g of high purity iron in 50 ml of conc hydrochloric acid and oxidize by drop wise addition of conc nitric acid. Evaporate to a syrupy consistency. Add 20 ml of conc hydrochloric acid and dilute to 200 ml. Add 20 g of sodium chloride and dilute to 1 litre with water.

D-2.4 *Lanthanum Chloride Solution* — Dissolve 50 g of lanthanum chloride in 50 ml of conc hydrochloric acid and 300 ml of water. Dilute to 1 litre.

D-3. Procedure — Transfer 1·00 g of finally ground sample in 250 ml volumetric flask. Add 30 g of sugar and 100 ml of water and shake vigorously. Dilute the solution to mark. Shake the solution at ten minute intervals for 1½ to 2 hours. Allow the material to settle. Filter through a coarse filter paper, a part of the solution.

D-3.1 *Solution for AAS Measurement* — Take 50 ml of filtered solution in a 250 ml volumetric flask and add 45 ml of background solution, 40 ml of lanthanum chloride solution and 4 ml of conc hydrochloric acid. Make up to volume.

D-3.2 *Calibration Solution* — Transfer 5·0, 10·0, 15·0, 20·0 and 25·0 ml of standard calcium solution to five 250-ml volumetric flasks. Add 60 ml of background solution, 40 ml of lanthanum chloride and 6 ml of conc hydrochloric acid. Dilute to volume and mix.

D-3.3 *Blank* — Carry out a blank on reagents used above.

D-3.4 *Adjustment of Atomic Absorption Spectrometer* — Set the initial parameter of the instrument as recommended by the manufacturer. Optimize the instrument response by adjusting wavelength, fuel and burner to get the maximum absorbance in accordance with the following:

a) Hallow cathode calcium lamp 'current' should be adjusted in accordance with the manufacturer's advice (typical value 10-15 mA).

b) Wavelength : 422·7 nm, and

c) Flow rate of nitrous oxide and acetylene should be adjusted as advised by the manufacturer (typical value 14 litres/min for nitrous oxide and 6·6 litres/min for acetylene).

D-3.5 *AAS Measurement* — Aspirate water to establish that absorbance reading is not drifting and then set the initial reading for water to zero absorbance. Aspirate blank solution, a sample solution and standard calcium solution. When a stable response has been obtained for each solution, record the readings. Aspirate water between each solution. Subtract the blank values from the standard solution as well as from the sample.

D-4. Calculation — Prepare a calibration curve by plotting net absorbance values of calibration solutions against μg of Ca/ml. Convert the absorbance values of test solution to μg of Ca by means of calibration curve.

Calculate the calcium as:

$$\text{Ca, percent} = \frac{I}{W} \times 100$$

where

I = μg of Ca/ml of test solution obtained from the calibration curve, and

W = sample conc in g/l of the test solution.

EXPLANATORY NOTE

The weathering test indicates the atmospheric effect with time on various characteristics of iron ore sinter specified in IS : 9959-1981 'Guidelines for iron ore sinters for iron making in blast furnaces'. This standard has been prepared to establish uniform practice for the determination of weathering effect on iron ore sinter.

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